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**UTILITY
PATENT APPLICATION
TRANSMITTAL**

Attorney Docket No.	82225.P1423D
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Total Pages
(all documents)

First Named Inventor or Application Identifier
Lam

BOARD LEVEL DECAPSULATOR

Express Mail Label No.

EM560888851 μ s

(Only for new nonprovisional applications under 37 CFR 1.53(b))

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

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| 1. | <input checked="" type="checkbox"/> *Fee Transmittal Form
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(preferred arrangement set forth below) | Total Pages | <div style="border: 1px solid black; width: 30px; margin: 0 auto; text-align: center;">18</div> |
| | <ul style="list-style-type: none"> - Descriptive Title of the Invention - Cross References to Related Applications - Statement Regarding Fed sponsored R&D - Reference to Microfiche Appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings (if filed) - Detailed Description - Claims - Abstract of the Disclosure | | |
| 3. | <input checked="" type="checkbox"/> Drawing(s) (35 USC 113) | Total Sheets | <div style="border: 1px solid black; width: 30px; margin: 0 auto; text-align: center;">2</div> |
| 4. | <input checked="" type="checkbox"/> Oath of Declaration | Total Pages | <div style="border: 1px solid black; width: 30px; margin: 0 auto; text-align: center;">2</div> |
| | <ul style="list-style-type: none"> a. <input type="checkbox"/> Newly executed (original copy) b. <input checked="" type="checkbox"/> Copy from prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed) <p style="text-align: center;">(Note Box 5 below)</p> <ul style="list-style-type: none"> i. <input type="checkbox"/> <u>DELETION OF INVENTOR(S)</u>
Signed statement attached deleting inventor(s) named in prior application, see 37 CFR 1.63(d)(2) and 1.33 (b). | | |
| 5. | <input type="checkbox"/> Microfiche Computer Program (Appendix) | | |
| 6. | <input type="checkbox"/> Nucleotide &/or Amino Acid Sequence Submission
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* Note for Items 1 & 13: In order to be entitled to pay small entity fees, a small entity statement is required (37 CFR §1.27), except if one filed in a prior application is relied upon (37 CFR §1.28)

ACCOMPANYING APPLICATION PARTS

7. ☒ Assignment Papers (cover sheet & document(s))
8. ☐ 37 CFR3.73(b) Statement ☐ Power of Attorney
(when there is an assignee)
9. ☐ English Translation Document (if applicable)
10. ☐ Information Disclosure ☐ Copies of IDS
Statement (IDS)/PTO-1449 Citations
11. ☒ Preliminary Amendment
12. ☒ Return Receipt Postcard (MPEP 503)
13. ☐ *Small Entity ☐ Statement filed in prior app
Statement(s) Status still proper and desired
14. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
15. ☐ Other:

16. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information below & in a preliminary amendment:

☐ Continuation ☒ Divisional ☐ Continuation-in-part (CIP) of prior application no: 08/740,380

Prior application information: Examiner: A. POWELL Group/Art Unit: 1763

For Continuation or Divisional Apps only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

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Signature

Date _____

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application for:)
Lam)
For: **BOARD LEVEL DECAPSULATOR**)
_____)

PRELIMINARY AMENDMENT

Honorable Commissioner of Patents
and Trademarks
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Sir:

Please amend the above-identified application as follows:

IN THE SPECIFICATION

After the title, please insert -- This is a divisional of application Serial No. 08/740,380 filed
October 29, 1996 --.

IN THE CLAIMS

Please cancel claims 1-8.

In Claim 10, line 1, please change "7" to -9--.

Please add the following claims:

1 --11. The method as recited in claim 9, further comprising the step of controlling a flow of
2 the decapsulation fluid through a pair of tubes that couple an extender to said injection head using a
3 corresponding pair of valves.

1 12. The method as recited in claim 9, further comprising the step of plugging a stub that
2 supports the printed circuit board into a substrate of said tray.

1 13. A method for decapsulating an integrated circuit package that is mounted to a first
2 surface of a printed circuit board, the printed circuit board having a second surface located below
3 the first surface of the printed circuit board, comprising the step of:

4 spraying a decapsulation fluid onto the integrated circuit package via an injection head
5 clamped to the integrated circuit package, said injection head having a nozzle disposed above the
6 integrated circuit package that is in fluid communication with an inlet port of said injection head,
7 and a return port that is in fluid communication with an outlet port of said injection head.

1 14. The method as recited in claim 13, further comprising the step of controlling a flow
2 of the decapsulation fluid through a pair of tubes that couple an extender to said injection head
3 using a corresponding pair of valves.

1 15. The method as recited in claim 13, further comprising the step of plugging a stub
2 that supports the printed circuit board into a substrate.

1 16. The method as recited in Claim 13 further comprising the step of forming a seal
2 between said injection head and said integrated circuit package. --

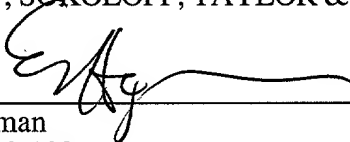
REMARKS

Entry of the foregoing amendments prior to the initial examination of the above-captioned
application is requested.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: June 17, 1999


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Our File No.: 082225.P1423

UNITED STATES PATENT APPLICATION

FOR

BOARD LEVEL DECAPSULATOR

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PREPARED BY:

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BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

5 The present invention relates to a system for decapsulating an integrated circuit package that is mounted to a printed circuit board.

2. DESCRIPTION OF RELATED ART

10

Integrated circuits (ICs) typically contain a plurality of surface pads that are connected to the circuit of the IC. After fabrication the IC can be tested by placing probe pins of a device tester onto the surface pads. Integrated circuits are typically assembled into a package that is soldered to a printed circuit board. Some packages are constructed from a molded plastic material that encapsulates the integrated circuit. The integrated circuit becomes inaccessible to external test equipment after the plastic material is molded onto the IC. It is sometimes desirable to test the integrated circuit after the plastic is molded around the IC.

15

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The integrated circuit can be exposed by decapsulating the plastic package within a device level decapsulation system (DLDS). The decapsulation system exposes a portion of the package to an etchant that
5 removes the plastic material without attacking the underlying integrated circuit. The etchant is applied to the package until the surface pads of the IC are exposed to the ambient. Probe pins can then be placed onto the surface pads to test the integrated circuit.

10 It is sometimes desirable to test an integrated circuit after the IC is mounted to a printed circuit board. Debugging an individual integrated circuit after assembly to a printed circuit board presently requires the removal of the package from the board.
15 The package is typically removed by applying heat to the assembly to reflow the solder joints. Reflowing and removing the package may damage the package leads, particularly packages which have fine high pitch lead counts. The reflow process also reduces the integrity
20 of the board.

It is also desirable to test integrated circuits while the IC packages are still mounted to the printed circuit board. Final assembly tests are particularly desirable for high speed devices that are sensitive to

the impedance of the circuit board. The device level
decapsulation systems of the prior cannot expose the IC
while the package is mounted to the printed circuit
board. It is therefore desirable to provide a system
5 that can decapsulate an integrated circuit package
while the package is mounted to a printed circuit
board.

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SUMMARY OF THE INVENTION

The present invention is a system that
decapsulates an integrated circuit package while the
package is mounted to a printed circuit board. The
system includes a tray that supports a printed circuit
board which has at least one integrated circuit package
mounted to the board. Mounted to the tray is a clamp
which clamps an injection head to the top of the
package. The injection head is coupled to a source of
decapsulation fluid which is sprayed onto the package.
The decapsulation fluid is circulated across the
package to remove the package material and expose the
underlying integrated circuit. The injection head has
a gasket that is pressed onto the package to prevent
the fluid from leaking onto the printed circuit board.
After the plastic is decapsulated the head can be
removed from the package so that the integrated circuit
can be tested while the circuit is connected to the
printed circuit board.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and advantages of the present invention will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, wherein:

Figure 1 is a schematic of a decapsulation system of the present invention;

10 Figures 2a-b are cross-sectional views of an injection head of the system;

Figures 3a-b are cross-sectional views of an extender of the system.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings more particularly by reference numbers, Figure 1 shows a system 10 for
5 decapsulating an integrated circuit package 12 that is mounted to a printed circuit board 14. The system 10 decapsulates the package 12 by removing a top portion of the package material to expose an underlying integrated circuit (IC) 16. Exposing the integrated
10 circuit 16 allows the probe pins (not shown) of a device tester to be placed onto the IC 16 while the package 12 is still mounted to the board 14.

The system 10 includes a tray 18 that supports the printed circuit board 14. The system 10 contains a
15 clamp 20 that is mounted to a substrate 22 of the tray 18. The clamp 20 has a leg portion 24 which supports a portion of the printed circuit board 14. The printed circuit board 14 is also supported by a plurality of stubs 26 that are plugged into corresponding apertures
20 28 of the substrate 22. The top surface of the substrate 22 preferably has a plurality of apertures 28 that allow the stubs 26 to be plugged into any location within the tray 18. The plugs 26 can be moved within

the tray 18 to compensate for printed circuit boards 14 that have different outer dimensions.

The clamp 20 has a screw 30 that presses an injection head 32 onto the top surface of the integrated circuit package 12. The injection head 32 sprays a decapsulation fluid onto the package 12. The decapsulation fluid removes the plastic material to expose the underlying integrated circuit 16. The head 32 has a gasket 34 that is pressed into the package 12. The gasket 34 is typically constructed from a material such as fluoric rubber that is inert to the decapsulation fluid. The gasket 34 prevents the decapsulation fluid from leaking onto the printed circuit board 14. The gasket 34 also allows the decapsulation fluid to be recaptured for further use. The dimensions and shape of the gasket 34 define the size and shape of the opening in the package 12.

The system 10 includes a decapsulation supply unit 36 which provides decapsulation fluid to the injection head 32. The unit 36 includes a pump 38 that circulates the fluid into the injection head 32 and across the package 12. The unit 36 also has a reservoir 40 and a valve 42 that controls the flow of fluid into the injection head 32. The valve 42 may be

actuated by a controller (not shown) that can be
programmed through a control panel. By way of example,
the operator can set a start and stop time to
decapsulate the package 12. The supply unit 36 may be
5 a product sold by Nippon Scientific Co. Ltd. under the
designation Plastic Mold Decapsulation System PA102.
The Nippon product is typically used to decapsulate
individual integrated circuit packages that are not
mounted to a printed circuit board 14.

10 To utilize the existing Nippon product the system
10 has an extender 44 that is mounted to the nozzle 46
of the unit 36. The extender 44 allows the injection
head 32 to be coupled to the unit nozzle by a pair of
tubes 48 which carry the decapsulation fluid. The
15 tubes 48 are typically constructed from TEFLON material
which is inert to the decapsulation fluid. The system
10 preferably contains a pair of stop cock valves 50
that allow an operator to terminate the flow of fluid
into the injection head 32. The tubes 48 are routed
20 through a plastic shield 52 which encloses the
injection head 32 and the circuit board 14.

Figures 2a-b show a preferred embodiment of an
injection head 32. The head 32 includes a nozzle 54
that is in fluid communication with an inlet port 56.

The nozzle 54 sprays the decapsulation fluid onto the package 12. The head 32 also has a pair of return ports 58 coupled to an outlet port 60. The inlet 56 and outlet 60 ports are coupled to the extender 44 by tubes 48. The injection head 32 is preferably constructed from a material such as high density polyethylene (HDPE) that is inert to the decapsulation fluid.

Figures 3a-b show a preferred embodiment of an extender 44 mounted to the nozzle interface 46 of the unit 36. The extender 44 has an intake port 62 that is in fluid communication with an outlet port 64, and aligned with a nozzle 66 of the unit 36. The intake port 62 and outlet port 64 direct the fluid into the injection head 32. The extender 44 also contains a pair of exhaust ports 68 that are in fluid communication with an inlet port 70, and aligned with a pair of return ports 72 of the unit 36. The exhaust 68 and inlet 70 ports direct the fluid from the injection head 32 to the unit 36. A seal 74 is preferably located between the nozzle 46 and the extender 44. The extender 44 is preferably constructed from an HDPE material.

In operation, a printed circuit board 14 and accompanying integrated circuit package 12 are placed onto the clamp leg 24 and stubs 26 of the tray 18. The screw 30 is manipulated to provide a clearance for the insertion of the injection head 32 onto the package 12. The screw 30 is then turned to secure the head 32 to the package 12. The valves 42 and 50 are opened to allow the decapsulation fluid to flow onto the package 12.

The fluid circulates through the head 32 until the package 12 is decapsulated and the integrated circuit 16 is exposed. The valve 42 is then closed to terminate the flow of fluid. The intake valve is typically closed first to evacuate the fluid from the head 32. The screw 30 is turned so that the head 32 can be detached from the package 12. The board is then removed so that the integrated circuit 16 can be tested.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and

described, since various other modifications may occur to those ordinarily skilled in the art.

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What is claimed is:

1 1. A system for decapsulating an integrated
2 circuit package that is mounted to a printed circuit
3 board, comprising:
4 a source of a decapsulation fluid;
5 a tray that supports the printed circuit board;
6 an injection head that is located adjacent to the
7 integrated circuit package, said injection head has a
8 nozzle and a return port that are coupled to said
9 source of decapsulation fluid to introduce the
10 decapsulation fluid to the integrated circuit package;
11 and,
12 a gasket that seals said injection head to the
13 integrated circuit package.

1 2. The system as recited in claim 1, further
2 comprising a clamp that clamps said injection head onto
3 the integrated circuit package.

1 3. The system as recited in claim 1, wherein said
2 source of decapsulation fluid includes an extender that
3 is coupled to a nozzle that provides the decapsulation
4 fluid.

1 4. The system as recited in claim 3, further
2 comprising a pair of tubes that couple said extender to
3 said injection head.

1 5. The system as recited in claim 4, further
2 comprising a pair of valves that control a flow of the
3 decapsulation fluid through said tubes.

1 6. The system as recited in claim 1, wherein said
2 tray includes a stub that supports the printed circuit
3 board and which is plugged into a substrate of said
4 tray.

1 7. A system for decapsulating an integrated
2 circuit package that is mounted to a printed circuit
3 board, comprising:

4 a substrate;

5 a clamp that is mounted to said substrate, said
6 clamp having a leg portion that supports the printed
7 circuit board;

8 a stub that is plugged into said substrate and
9 which supports the printed circuit board;

10 a decapsulation fluid unit which has a nozzle that
11 provides a decapsulation fluid, and a return port that
12 receives the decapsulation fluid;

13 an extender that has an intake port that is in
14 fluid communication with an outlet port of said
15 extender and said nozzle of said decapsulation fluid
16 unit, and an exhaust port that is in fluid
17 communication with an inlet port of said extender and
18 said return port of said decapsulation fluid unit;

19 an injection head that is clamped to the
20 integrated circuit package by said clamp, said
21 injection head has a nozzle that is in fluid
22 communication with an inlet port of said injection
23 head, and a return port that is in fluid communication
24 with an outlet port of said injection head;

25 a first tube that couples said outlet port of said
26 extender with said inlet port of said injection head;

27 a second tube that couples said inlet port of said
28 extender with said outlet port of said injection head;
29 and,

30 a gasket that seals said injection head to the
31 integrated circuit package.

1 8. The system as recited in claim 4, further
2 comprising a pair of valves that control a flow of the
3 decapsulation fluid through said tubes.

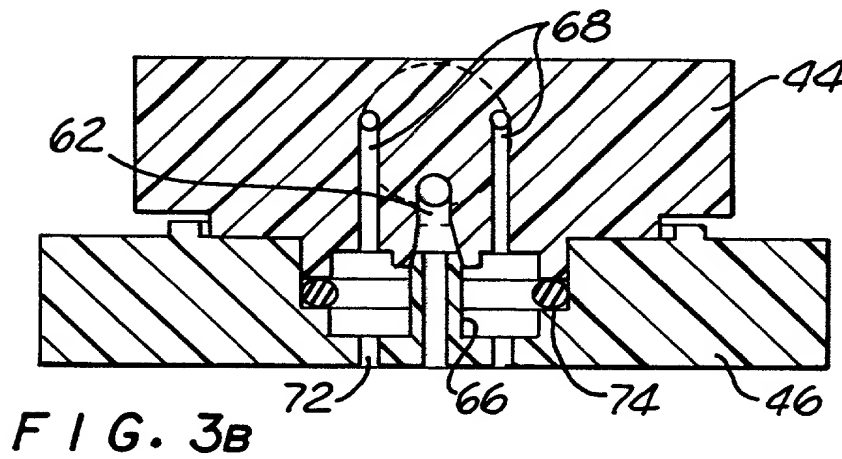
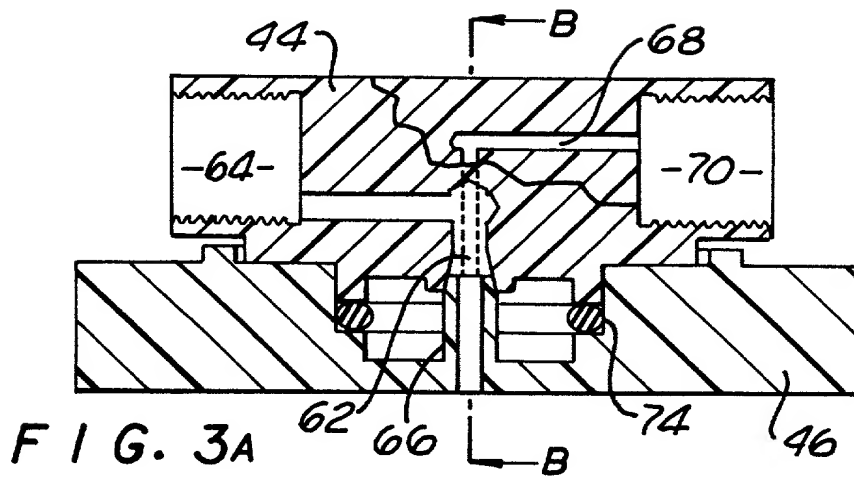
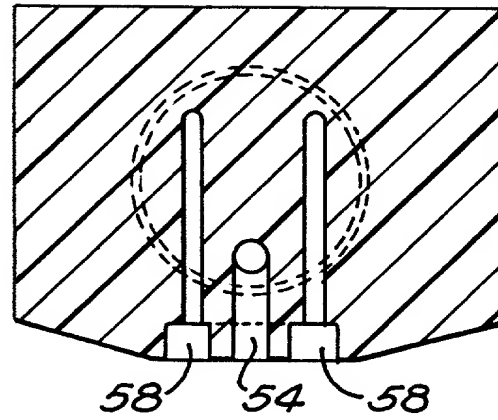
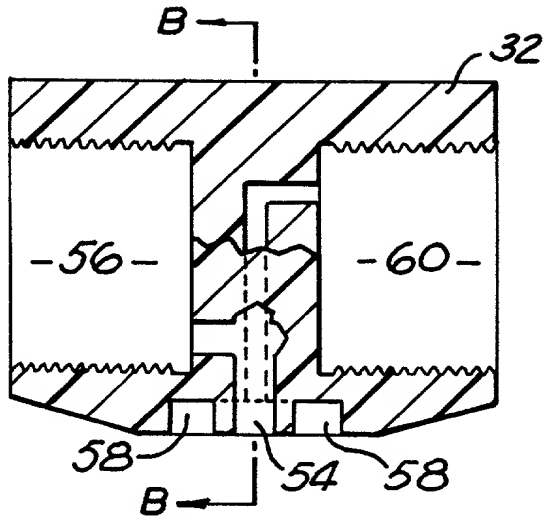
1 9. A method for decapsulating an integrated
2 circuit package that is mounted to a printed circuit
3 board, comprising the steps of:

- 4 a) providing an injection head that sprays a
5 decapsulation fluid;
6 b) placing the printed circuit board onto a tray;
7 c) clamping said injection head onto the
8 integrated circuit package; and,
9 d) spraying the decapsulation fluid onto the
10 integrated circuit package.

1 10. The method as recited in claim 7, further
2 comprising the step of moving a stub that is plugged
3 into said tray and which supports the printed circuit
4 board before the printed circuit board is placed onto
5 said tray.

ABSTRACT OF THE DISCLOSURE

A system that decapsulates an integrated circuit package while the package is mounted to a printed circuit board. The system includes a tray that supports a printed circuit board which has at least one integrated circuit package mounted to the board. Mounted to the tray is a clamp which clamps an injection head to the top of the package. The injection head is coupled to a source of decapsulation fluid which is sprayed onto the package. The decapsulation fluid is circulated across the package to remove the package material and expose the underlying integrated circuit. The injection head has a gasket that is pressed onto the package to prevent the fluid from leaking onto the printed circuit board. After the plastic is decapsulated the head can be removed from the package so that the integrated circuit can be tested while the circuit is connected to the printed circuit board.



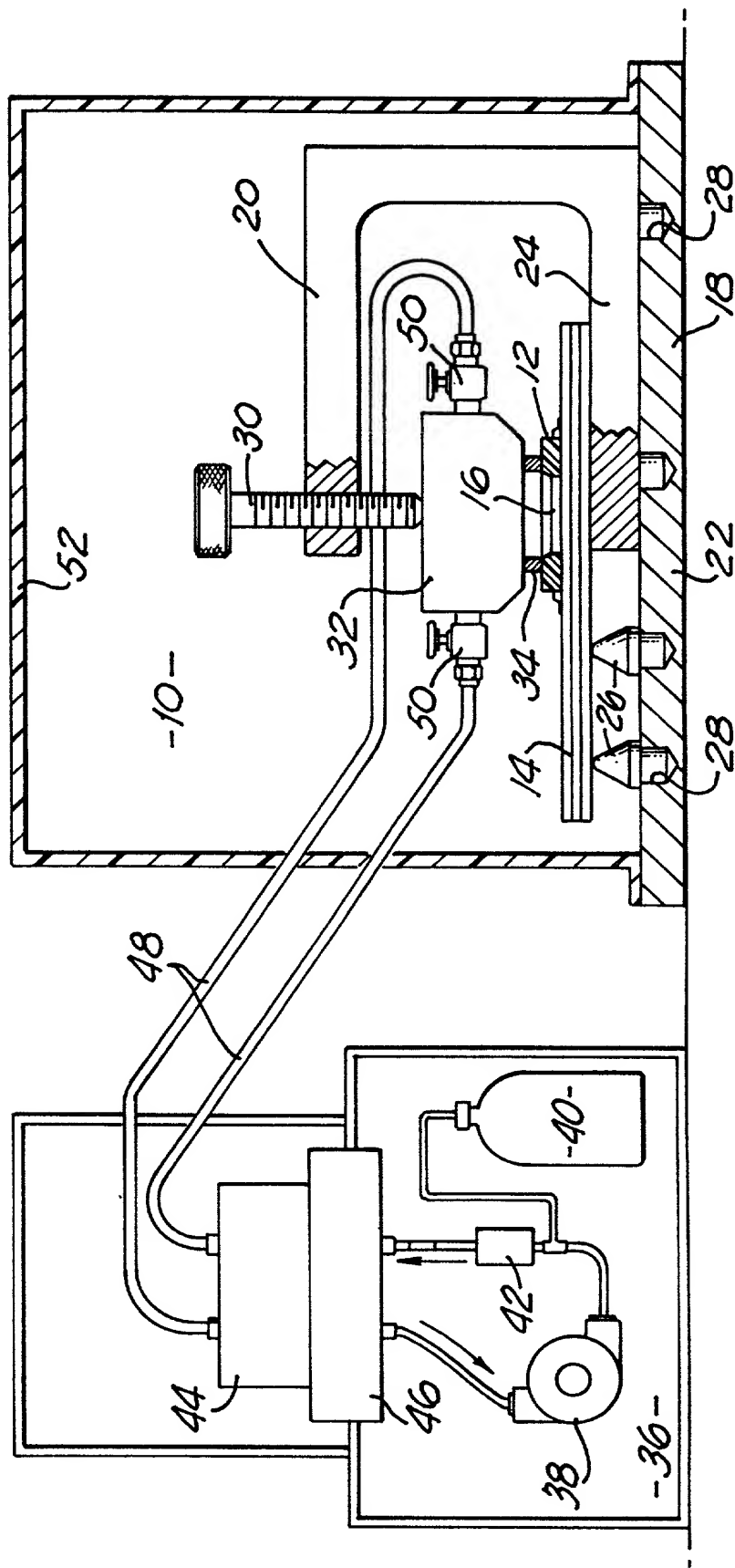


FIG. 1

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name,

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

BOARD LEVEL DECAPSULATOR

the specification of which

XXXXX is attached hereto.
_____ was filed on _____ as Application No. _____
and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I do not know and do not believe that the same was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months prior to this application.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s) Priority Claimed

Number	Country	Day/Month/Year Filed	Yes	No
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I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

_____ (Application No.)	_____ (Filing Date)	_____ (Status -- patented, pending, abandoned)
----------------------------	------------------------	--

I hereby appoint Aloysius T. C. AuYeung, Reg. No. 35,432; William Thomas Babbitt, Reg. No. 39,591; Kent D. Baker, Reg. No. 38,822; Jordan Michael Becker, Reg. No. 39,602; Bradley J. Berezna, Reg. No. 33,474; Michael A. Bernadico, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; Gregory D. Caldwell, Reg. No. 39,926; Kent M. Chen, Reg. No. 39,630; Lawrence M. Cho, Reg. No. 39,942; Thomas M. Coester, Reg. No. P39,637; Roland B. Cortes, Reg. No. 39,152; William Donald Davis, Reg. No. 38,428; Daniel M. De Vos, Reg. No. 37,813; Karen L. Feisthamel, Reg. No. 40,264; David R. Halvorson, Reg. No. 33,395; Eric Ho, Reg. No. P39,711; George W. Hoover II, Reg. No. 32,992; Eric S. Hyman, Reg. No. 30,139; Jeffrey D. Jacobs, Reg. No. 40,029; Dag H. Johansen, Reg. No. 36,172; Stephen L. King, Reg. No. 19,180; Dolly M. Lee, Reg. No. 39,742; Daniel C. Mallery, Reg. No. 33,532; Michael J. Mallie, Reg. No. 36,591; Kimberley G. Nobles, Reg. No. 38,255; Ronald W. Reagin, Reg. No. 20,340; James H. Salter, Reg. No. 35,668; William W. Schaal, Reg. No. 39,018; James C. Scheller, Reg. No. 31,195; Maria McCormack Sobrino, Reg. No. 31,639; Stanley W. Sokoloff, Reg. No. 25,128; Allan T. Sponseller, Reg. No. 38,318; Steven R. Sponseller, Reg. No. 39,384; David R. Stevens, Reg. No. 38,626; Edwin H. Taylor, Reg. No. 25,129; Lester J. Vincent, Reg. No. 31,460; John Patrick Ward, Reg. No. 40,216; Ben J. Yorks, Reg. No. 33,609; and Norman Zafman, Reg. No. 26,250; my attorneys; and Gary B. Goates, Reg. No. 35,159; Michael Anthony DeSanctis, Reg. No. 39,957; Charles E. Shemwell, Reg. No. 40,171; Edwin A. Sloane, Reg. No. 34,728; and Judith A. Szepesi, Reg. No. 39,393; my patent agents, of BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800, and Erwin Basinski, Reg. No. 34,773; Timothy J. Crean, Reg. No. 37,116; Kang S. Lim, Reg. No. 37,491; Philip J. McKay, Reg. No. 38,966; Lee Patch, Reg. No. 30,095; Matthew C. Rainey, Reg. No. 32,291; and Leland Z. Wiesner, Reg. No. 39,424 of Sun Microsystems, Inc., with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor: Chung Lam

Inventor's Signature

Chung Lam

Date 10/24 - 1996

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